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Part IV

# Environmental Protection Agency

## Ammonium Sulfate Manufacture; Proposed Standards of Performance and Notice of Public Hearing

**ENVIRONMENTAL PROTECTION AGENCY**

**40 CFR Part 60**

**[FRL 1353-3]**

## Standards of Performance for New Stationary Sources; Ammonium Sulfate Manufacture

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Proposed Rule and Notice of Public Hearing.

**SUMMARY:** The proposed standards would limit atmospheric emissions of particulate matter from new, modified, and reconstructed ammonium sulfate manufacturing dryers. The standards implement section 111 of the Clean Air Act and are based on the Administrator's determination that ammonium sulfate manufacturing plants contribute significantly to air pollution. The intended effect is to require new, modified, and reconstructed ammonium sulfate manufacturing plants to use the best demonstrated system of continuous emission reduction, considering costs, nonair quality health and environmental impact, and energy impacts.

A public hearing will be held to provide interested persons an opportunity for oral presentation of data, views, or arguments concerning the proposed standards.

**DATES:** *Comments.* Comments must be received on or before April 5, 1980.

*Public Hearings.* The public hearing will be held on March 6, 1980 (about 30 days after proposal) beginning at 9 a.m.

*Request to Speak at Hearing.* Persons wishing to present oral testimony at the hearing should contact EPA by February 29, 1980 (one week before hearing).

**ADDRESSES:** *Comments.* Comments should be submitted (in duplicate if possible) to Central Docket Section (A-130), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460, Attention: Docket No. A-79-31.

*Public Hearing.* The public hearing will be held at The Environmental Research Center Auditorium Rm B-102, Research Triangle Park, N.C. Persons wishing to present oral testimony should notify Shirley Tabler, Emission Standards and Engineering Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5421.

*Background Information Document.* The background information document for the proposed standards may be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone number (919) 541-2777. Please refer to "Ammonium Sulfate Manufacture—Background Information for Proposed Emission Standards," EPA-450/3-79-034.

*Docket.* A docket, number A-79-31, containing information used by EPA in development of the proposed standards, is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section (A-130), Room 2903B, Waterside Mall, 401 M Street, SW., Washington, D.C. 20460.

**FOR FURTHER INFORMATION CONTACT:** Mr. Don R. Goodwin, Director, Emission Standards and Engineering Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5271.

**SUPPLEMENTARY INFORMATION:**

### Proposed Standards

The proposed standards would limit atmospheric particulate matter emissions from new, modified, and reconstructed ammonium sulfate dryers at caprolactam by-product ammonium sulfate plants, synthetic ammonium sulfate plants, and coke oven by-product ammonium sulfate plants.

Specifically, the proposed standards would limit exhaust emissions from ammonium sulfate dryers to 0.15 kilogram of particulate matter per megagram of ammonium sulfate production (0.30 lb/ton). An opacity emission standard is also proposed and would limit emissions from the affected facility to no more than 15 percent.

The proposed standards would require continuous monitoring of the pressure drop across the control system for any affected facility to help ensure proper operation and maintenance of the system. Flow monitoring devices necessary to determine the mass flow of ammonium sulfate feed material to the process would also be required.

### Summary of Environmental, Energy, and Economic Impacts

The proposed standards would reduce projected 1985 particulate emissions from new, modified, and reconstructed ammonium sulfate dryers from about 670 megagrams (737 tons) per year, the level of emissions under a typical State Implementation Plan, to about 131 megagrams (144 tons) per year. Compliance with the proposed standards would amount to an 80 percent reduction of particulate emissions under a State Implementation Plan and would bring the overall collection efficiency to near 99.9 percent of the uncontrolled emissions. This reduction in emission would result in reduction of ambient air concentrations of particulate matter in the vicinity of new, modified, and reconstructed ammonium sulfate plants. The proposed standards are based on the use of venturi scrubbing or fabric filtration to control particulate matter. No water discharge would be generated by the control equipment required and all captured particulate matter would be reclaimed; therefore, the proposed standards would have no adverse impact on water quality or solid waste.

The proposed standards would not significantly increase energy consumption at ammonium sulfate plants and would have a minimal impact on national energy consumption. The incremental energy needed to operate control equipment to meet the standards would range from 0.10 percent of the total energy required to run a synthetic or coke oven by-product ammonium sulfate plant to 0.65 percent of the total energy required to operate a caprolactam by-product ammonium sulfate plant.

Economic analysis indicates that the impact of the proposed standards is reasonable. Cumulative capital costs of complying with the proposed standards for the ammonium sulfate industry as a whole would be about $1.0 million by 1985. Annualized cost to the industry in the fifth year of the proposed standards would be about $0.5 million. The industry-wide price increase necessary to offset the cost of compliance would amount to less than 0.01 percent of the wholesale price of ammonium sulfate. Costs of emission control required by the proposed standards are not expected to prevent or hinder expansion or continued production in the ammonium sulfate industry.

### Rationale

#### *Selection of Source for Control*

The Priority List (40 CFR 60.16, 44 FR 49222, August 21, 1979) identifies various sources of emissions on a nationwide basis in terms of quantities of emission from source categories, the mobility and competitive nature of each source category, and the extent to which each pollutant endangers health and welfare. The Priority List reflects the Administrator's determination that emissions from the listed source categories contribute significantly to air pollution and is intended to identify major source categories for which standards of performance are to be promulgated. The ammonium sulfate manufacturing industry is listed among

those source categories for which new source performance standards (NSPS) must be promulgated.

Ammonium sulfate has been an important nitrogen fertilizer for many years. Its early rise to importance as a fertilizer resulted from its availability as a by-product from such basic industries as steel manufacturing and petroleum refining. By-product generation has continued to dominate the industry. By-product ammonium sulfate from the caprolactam segment of the synthetic fibers industry is now the single largest source, accounting for more than 50 percent of ammonium sulfate production.

Production of ammonium sulfate as a by-product also ensures that it will continue as an important source of nitrogen fertilizer in the United States. This is illustrated by the fact that, in response to an increase in demand, caprolactam production is expected to increase at compounded annual growth rates of up to 7 percent through the year 1985; and for every megagram of caprolactam produced, 2.5 to 4.5 megagrams of ammonium sulfate are produced as a by-product.

Over 90 percent of ammonium sulfate is generated from three types of plants: Synthetic, caprolactam by-product, and coke oven by-product. Investigation has shown that the impact of regulation and potential for emission reduction is significant only within these three industry sectors. Synthetic ammomium sulfate is produced by the direct combination of ammonia and sufuric acid. Caprolactam ammomium sulfate is produced as a by-product from streams generated during caprolactam manufacture. Ammonia recovered from coke oven off-gas is reacted with sulfuric acid to produce coke oven ammonium sulfate. These three major segments of the ammonium sulfate industry would be regulated by the proposed new source performance standards.

*Selection of Pollutant*

Study of the ammonium sulfate industry has shown that ammonium sulfate emissions are the principal pollutant emitted to the atmosphere from ammonium sulfate plants. At operating temperatures, the ammonium sulfate emissions occur as solid particulate matter, a "criteria" pollutant for which national ambient air quality standards have been promulgated.

Currently, a variety of wet collection systems are employed to control ammonium sulfate particulate emissions to levels of compliance with State and local air pollution regulations (typically a reduction of 97 to 98 percent). Existing State regulations range from a low of 0.71 kilogram of particulate per megagram of ammonium sulfate production to a high of 1.3 kilograms per megagram. By the year 1985, new, modified, and reconstructed ammonium sulfate manufacturing dryers would cause annual nationwide particulate emissions to increase by about 670 Mg/year (737 tons/year), with emissions controlled to the level of a typical State Implementation Plan (SIP) regulation. (Estimate based on growth rate demonstrated over past decade.)

Volatile organic compounds (VOC) are also emitted from process dryers at caprolactam by-product ammonium sulfate plants. Test data indicate that the caprolactam VOC mass emissions are largely in the vapor phase and at least two orders of magnitude lower than ammonium sulfate particulate emissions (110 kg/Mg for particulate matter versus 0.78 kg/Mg for the VOC emissions). In addition, wet collectors currently in use as particulate control systems have demonstrated an 88 percent removal efficiency of uncontrolled caprolactam VOC emissions. At this control level, new, modified, and reconstructed caprolactam ammonium sulfate plants would add only about 76 megagrams per year to nationwide VOC emissions by 1985. Therefore, the only pollutant recommended for control by the proposed standards is particulate matter.

*Selection of the Affected Facility*

Ammonium sulfate crystals are formed by continuously circulating a mother liquor through a crystallizer. When optimum crystal size is achieved, precipitated crystals are separated from the mother liquor (dewatered) usually by centrifuges. Following dewatering, the crystals are dried and screened to product specifications.

Nearly all of the particulate matter emitted to the atmosphere from ammonium sulfate manufacturing plants is in the gaseous exhaust streams from the process dryers. Other plant processes, such as crystallization, dewatering, screening, and materials handling, are not significant emission sources.

Ammonium sulfate dryers can be either of the fluidized bed or the rotary drum type. All fluidized bed units found in the industry are heated continuously with steam-heated air. The rotary units are either direct-fired or steam heated. Air flow rates for the ammonium sulfate dryers at caprolactam plants range from 560 scm/Mg of product to 3,200 scm/Mg of product. The lower value represents direct-fired rotary drum units and the higher value represents fluidized bed drying units using steam-heated air. At synthetic plants, air flow rates range from 360 scm/Mg to 770 scm/Mg of product. All drying units at synthetic plants are of the rotary drum type.

One consequence of the wide range of gas flow rates for the differing drying systems is that particulate emission rates, which are directly related to the gas-to-product ratio, also vary considerably for each drying unit involved. (Gas-to-product ratio is defined as the volume of dryer exhaust gas per unit of production, e.g., dry standard cubic meters per megagram of ammonium sulfate produced.) Emission tests using EPA Method 5 show an uncontrolled ammonium sulfate emission range of 0.44 kg/Mg to 76.7 kg/Mg for rotary dryers. The one fluidized bed dryer tested showed an uncontrolled emission rate of 110 kg/Mg of ammonium sulfate production.

Since the process dryer is the only significant source of ammonium sulfate particulate emissions, the ammonium sulfate manufacturing industry can be effectively controlled by specifying emission limitations for the process dryer. Therefore, the ammonium sulfate dryer has been selected as the affected facility for which particulate matter regulations are proposed.

*Selection of the Format of the Recommended Standards*

A number of regulatory formats are available for standards limiting the emission of particulate matter to the atmosphere. Among the formats judged as inappropriate for application in the ammonium sulfate industry were a mass per unit time performance standards and such non-performance standards as design, equipment, work practice, and operational specifications. A standard based on mass per unit time (e.g., kg/hr) would require that a relationship be constructed showing how the allowable mass rate of emissions would vary with both production and time. Such a relationship could not be determined without extensive source tests performed at great expense.

Section 111(h) of the Clean Air Act establishes a presumption against design, equipment, work practice, and operational standards. For example, a standard based on a specific type of drying equipment without add-on controls or a standard limiting the dryer air flow rate cannot be promulgated unless a standard of performance is not feasible. Performance standards for control of ammonium sulfate dryer particulate emissions have been determined as practical and feasible; therefore, design, equipment, work

practice, or operational standards were not considered as regulatory options.

Two additional formats for the proposed standards were considered: mass standards, which limit emissions per unit of feed to the ammonium sulfate dryer or per unit of ammonium sulfate processed by the dryer; and concentration standards, which limit emissions per unit volume of exhaust gases discharged to the atmosphere.

Mass standards, expressed as allowable emissions per unit of production, are related directly to the quantity of particulate matter discharged to the atmosphere. They regulate emissions based on units of input or output, thereby denying any dilution advantage. Mass standards also allow for variation in process techniques such as decreasing the air flow rate through the dryer. A primary disadvantage of mass standards, as compared to concentration standards, is that their enforcement may be more time consuming and therefore more costly. The more numerous measurements and calculations required also increase the opportunities for error. Determining mass emissions requires the development of a material balance on process data concerning the operation of the plant, whether it be input flow rates or production flow rates. The need for such a material balance is particularly relevant in the case of ammonium sulfate plants. The determination of throughput in the ammonium sulfate dryer is seldom direct. None of the plants investigated during development of the proposed standards made direct measurements of the dryer input or output. Process weights were determined indirectly through monitoring of input stream feed rates.

In general, enforcement of concentration standards requires a minimum of data and information, thereby decreasing the costs of enforcement and reducing the chances of error. However, in the ammonium sulfate industry, enforcement of concentration standards may be complicated by use of two-stage fluidized bed dryers which add ambient air streams at the discharge end of the dryer. There is a potential for circumventing concentration standards by diluting the exhaust gases discharged to the atmosphere with excess air, thus lowering the concentration of pollutants emitted but not the total mass emitted. For combustion operations, this problem can usually be overcome by correcting the concentration measured in the gas stream to a reference condition such as a specified oxygen or carbon dioxide percentage in the gas stream. However, in the ammonium sulfate industry the drying process frequently does not involve direct combustion operations. The drying air may be heated by an outside source; therefore, it is not always possible to "correct" the amount of exhaust air to account for dilution.

Since design dryer gas flow rates vary from process to process, concentration standards applied to the ammonium sulfate industry would penalize those plant operators who chose to use a low air flow rate for the ammonium sulfate dryer. A decrease in the amount of dryer air decreases the volume of gases released but not necessarily the quantity of particulate matter emitted. As a result, the concentration of particulate matter in the exhaust gas stream would increase even though the total mass emitted might remain nearly the same.

Because mass standards directly limit the amount of particulate matter emitted into the atmosphere per megagram of ammonium sulfate production, the same emission limit can be applied to all dryer types and sizes, production rates, and air flow rates. The flexibility of mass standards to accommodate process variations, such as the wide gange of gas-to-product ratios found in the industry, allows all segments of the ammonium sulfate industry to be regulated with a single mass emission standard. These advantages outweigh the drawbacks associated with the determination of process weight. Consequently, mass standards were judged more suitable for regulation of particulate emissions from ammonium sulfate dryers and were selected as the format for expressing the standards of performance for ammonium sulfate manufacturing plants.

The mass limit proposed will apply to the exhaust gas streams as they discharge from control equipment. The proposed standards express allowable particulate emissions in kilograms per megagram (kg/Mg) of ammonium sulfate production.

*Selection of the Best System of Emission Reduction and the Numerical Emission Limits*

Section 111 of the Clean Air Act requires that standards of performance reflect the degree of emission control achievable through application of the best demonstrated technological system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction, any nonair quality health and environmental impact, and energy requirements) has been adequately demonstrated. The proposed standards were developed based on information derived from (1) available technical literature on the ammonium sulfate manufacturing industry and applicable emission control technology, (2) technical studies performed for EPA by independent research organizations, (3) information obtained from the industry during visits to ammonium sulfate plants and meetings with various representatives of the industry, (4) comments and suggestions solicited from experts, and (5) results of emission measurements conducted by EPA.

*Control Technology*

Both venturi scrubbing and fabric filtration represent the most efficient add-on control techniques available to abate particulate emissions. In application to particulate collection from ammonium sulfate dryers, both have the potential to reduce ammonium sulfate emissions from process dryers to less than 0.15 kilogram per megagram of ammonium sulfate production, although energy requirements and costs may differ considerably.

Venturi scrubbers are most suitable for application to ammonium sulfate dryers. In caprolactam by-product ammonium sulfate plants, ammonium sulfate feed streams are used as a scrubbing liquor and in synthetic ammonium sulfate plants the condensate from the reactor/crystallizer is used as the scrubbing liquor. This allows the collected particulate to be easily recycled to the system without the addition of excess water. Because medium-energy (25 to 33 centimeters water guage (W.G.) pressure drop) venturi scrubbing with high liquid-to-gas ratios achieves a high collection efficiency and because venturi scrubbing is compatible with and complimentary to the processes involved, it is considered the most attractive add-on control system.

The fabric filter baghouse should also be able to achieve the level of control required by the standards based on similar applications in other industries. Normal operation of a baghouse for ammonium sulfate particulate collection, i.e., at temperatures above the dewpoint of the exhaust gas, should be feasible. However, in asseessing fabric filters as an emission control option, the following factors must be considered. For high gas flow rates, capital and operating costs as well as energy requirements are higher for fabric filters than for medium energy scrubbers of the same construction material. For caprolactam by-product plants using steam-heated fluidized bed dryers, the ratio of gas flow to product rate is at least an order of magnitude higher than that of the direct-fired rotary drum dryer operating with fabric filters. As the size of a

baghouse becomes larger, capital and annual operating costs increase. For example, maintaining the temperature of the exhaust gas and baghouse surfaces above the dewpoint may require more energy than would ordinarily be required to operate the dryer.

With caprolactam by-product ammonium sulfate plants apparently providing most of the anticipated growth in the ammonium sulfate industry, consideration should also be given to caprolactam VOC mass emissions from ammonium sulfate dryers. Available test data indicate that most of the caprolactam emissions associated with the ammonium sulfate dryer are in the vapor state. This suggests that the caprolactam emissions would pass through a fabric filter collection system. On the other hand, a venturi scrubber has demonstrated removal efficiency of 88 percent of the caprolactam from ammonium sulfate dryers. Thus, use of venturi scrubbers would, at a minimum, maintain existing VOC control levels now achieved by in-use wet collection systems.

*Emission Tests*

Based on a survey of the ammonium sulfate production industry, four plants were selected for EPA Method 5 particulate emission testing. These four ammonium sulfate manufacturing plants were then tested by EPA in order to evaluate control techniques currently used for controlling particulate emissions from ammonium sulfate dryers.

Presently throughout the ammonium sulfate industry, a variety of wet-scrubbing systems are employed to control ammonium sulfate particulate emissions. The majority of these are low-energy wet scrubbers, although medium-energy venturi scrubbers are being used with some ammonium sulfate dryers. For wet scrubbing systems in general, collection efficiency tends to increase with increased energy input, i.e., the higher the pressure drop, the higher the removal efficiency of particulates. This was borne out by analysis of EPA test results. For example, a synthetic ammonium sulfate plant, with a rotary drum drying facility controlled by a low-energy wet scrubber operating at a pressure drop of 15 centimeters (6 inches) W.G., showed a particulate collection efficiency of 97 percent. EPA test results from facilities with increased energy inputs, e.g., venturi scrubbers operating at pressure drops of 25.9 centimenters and 33 centimeters (10 and 13 inches) W.G. showed typically higher control efficiencies. In these latter cases, control efficiencies of 99.8 and 99.9 percent by weight were demonstrated with outlet particulate emission rates of 0.158 kg/Mg and 0.156 kg/Mg of ammonium sulfate production, respectively, at a synthetic ammonium sulfate plant using a rotary dryer and a caprolactam by-product ammonium sulfate plant using a fluidized bed dryer.

Additional emission test data on wet scrubbing control units have been provided by ammonium sulfate plant operators. At one facility, test results using EPA Method 5 show an average particulate emission rate of 0.135 kg/Mg of ammonium sulfate production. The facility, a caprolactam ammonium sulfate plant with a fluidized bed dryer, is controlled by a centrifugal scrubber preceded by a series of cyclones. The scrubber operates at 34 centimeters (13.4 inches) W.G. pressure drop.

Alternative emission control techniques were also examined. The one dry ammonium sulfate particulate control system in use (a fabric filter unit) was tested by EPA because it represents a unique application of this control method in the ammonium sulfate industry. The facility, a synthetic ammonium sulfate plant using a rotary dryer, did achieve a low mass emission rate, 0.007 kg/Mg (0.014 lb/ton); however, this emission rate is not considered representative of a typical ammonium sulfate facility. For example, the baghouse in use was originally designed for another application, and the gas flow rate to this unit is appreciably lower than normal direct-fired gas flow. This constraint on gas flow rate, by restricting the ratio of dryer exhaust gas-to-product rate, results in a significantly lower uncontrolled inlet emission rate than most other dryers used in the industry. In fact, the fabric filter inlet uncontrolled particulate emission rate was 0.41 kg/Mg of production, while those of facilities controlled by venturi scrubbers were 110 kg/Mg and 77 kg/Mg. This represents an uncontrolled mass emission difference in the range of two orders of magnitude. Thus, comparison of the outlet mass emissions for this facility with those of the other facilities tested is, in this situation, somewhat misleading.

*Regulatory Options*

Review of the performance of the emission control techniques led to the identification of two regulatory options. The two options are based on emission control techniques representative of two distinct levels of control. Each option specifies numerical emission limits for ammonium sulfate dryers applicable to the three major sectors of the ammonium sulfate industry. Option I is equivalent to no additional regulatory action. For this option, particulate emission levels would be set by existing SIP regulations, typically in the range of 0.71 kg/Mg to 1.3 kg/Mg of ammonium sulfate production. This option is characterized by the use of a low energy wet scrubber to meet the required emission limit, a reduction of 97 to 98 percent. Option II, based on the use of a venturi scrubber or fabric filter, would set an emission limit of 0.15 kilogram of particulate per megagram of ammonium sulfate production. As applied to the ammonium sulfate industry, both the venturi scrubber and the fabric filter control systems are capable of greater than 99.9 percent control efficiency. Option II therefore represents the most stringent control level that can be met by all segments of the ammonium sulfate industry.

Using model plants for the new, modified, and reconstructed ammonium sulfate facilities, the environmental impacts, energy impacts, and economic impacts of each regulatory option were analyzed and compared. Each ammonium sulfate manufacturing sector is unique from a technical standpoint. Dryer types and sizes, gas-to-product flow rates, and uncontrolled particulate emission rates vary from one sector to another and often within each sector. For these reasons it was apparent that no single model plant could adequately characterize the ammonium sulfate industry. Accordingly, several model dryers were specified in terms of the following parameters: Production rate, dryer types, exhaust gas flow rates, emission rates, stack height, stack diameter, and exit gas temperatures. The evaluation of these parameters may be found in Chapters 6, 7, and 8 of the document, "Ammonium Sulfate Manufacture—Background Information for Proposed Emission Standards."

Under Option I, annual nationwide particulate emissions from new, modified, and reconstructed ammonium sulfate manufacturing plants would increase by about 670 Mg/year (737 tons/year) between 1980 and 1985. Under Option II, nationwide particulate emissions would increase by 131 Mg/year (144 tons/year) during the same period. This represents a reduction of about 80 percent in the particulate emissions emitted under Option I, a typical SIP regulation.

Dispersion analysis under "worst case" atmospheric and meteorological conditions shows that the maximum 24-hour concentration of particulates in the vicinity of a new, modified, and reconstructed ammonium sulfate plant would be reduced by a factor of 80

percent (from 224 to 47.4 micrograms per cubic meter) by controlling to Option II rather than the SIP emission limit. The maximum annual average is reduced from 29.1 to 6.15 micrograms per cubic meter under Option II.

Effluent guidelines set forth in 40 CFR 418.60 limit water pollution from synthetic and coke oven ammonium sulfate plants. In the caprolactam by-product ammonium sulfate plant, water is removed in the crystallizer, condensed and recycled to the principal plant for plant use. The addition of a scrubber for emission control would not create a water pollution problem since all scrubbing liquor would be recycled to the process. The use of a baghouse would not create a water pollution problem since it is a dry collection system. Consequently, the water pollution impact of Option II would be zero.

The ammonium sulfate plants generate no solid waste as part of the process since all collected ammonium sulfate is recycled to the process. Furthermore, no significant increase in noise level is anticipated under Option II.

For typical plants in the ammonium sulfate manufacturing industry, an increase in energy consumption would result from compliance with Option II. The energy required, in excess of that required by a typical SIP regulation, to control caprolactam by-product ammonium sulfate plants to the level of Option II would be 8.8 gigawatt hours of electricity per year in 1985 using venturi scrubbers. The overall energy increase would amount to less than 0.65 percent of the total energy required to operate a typical caprolactam by-product ammonium sulfate plant. For synthetic and for coke oven by-product ammonium sulfate plants, the 1985 incremental energy increase would be 0.61 and 0.14 gigawatt hours per year, respectively, or less than a 0.1 percent increase. The total industry-wide energy increment would be 9.5 gigawatt hours per year in 1985. This figure indicates that Option II would not significantly increase energy consumption at ammonium sulfate plants and would have minimal impact on national energy consumption.

Economic analysis also indicates that the impact of Option II is minimal. The capital cost of the installed emission control equipment necessary to meet Option II, on all new, modified, and reconstructed ammonium sulfate facilities coming on line nationwide during the period 1980 to 1985, would be about $958,000. The total annualized cost of operating this equipment during the same period would be about $480,200. These costs are considered reasonable, and are not expected to prevent or hinder expansion or continued production in the ammonium sulfate manufacturing industry. The incremental cost necessary to offset the cost of meeting Option II would be about 0.01 percent of the wholesale price of ammonium sulfate.

Consideration of the beneficial impact on national particulate emissions; the lack of water pollution impact or solid waste impact; the minimal energy impact; the reasonable cost impact; and the general availability of demonstrated emission control technology leads to the selection of Option II as the basis for the proposed standards of performance for ammonium sulfate dryers.

*Selection of Opacity Emission Limits*

The best indirect method of ensuring proper operation and maintenance of emission control equipment is the specification of exhaust gasopacity limits. Determining an acceptable exhaust gas opacity limit is possible because opacity levels were evaluated for ammonium sulfate dryers during EPA tests; therefore, the data base for the particulate standards includes information on opacity. Ammonium sulfate dryers were observed to have no opacity readings greater than 15 percent opacity, and a total of 90 minutes of opacity of less than or equal to 15 percent but greater than 10 percent during observation periods of 180, 120, 438, and 408 minutes (1146 minutes total). Therefore, a standard of 15 percent opacity is proposed for all affected facilities to ensure proper operation and maintenance of control systems on a day-to-day basis.

*Selection of Performance Test Methods*

The use of EPA Reference Method 5—"Determination of Particulate Emissions from Stationary Sources" would be required to determine compliance with the mass standards for particulate matter emissions. Results of performance tests using Method 5 conducted by EPA on existing ammonium sulfate dryers comprise a major portion of the data base used in the development of the proposed standards. EPA Reference Method 5 has been shown to provide a representative measurement of particulate matter emissions. Therefore, it is included for the purpose of determining compliance with the proposed standards.

Method 5 calculations require imput data obtained from three other EPA test methods conducted previous to the performance of Method 5. Method 1, "Sample and Velocity Traverse for Stationary Sources," must be used to obtain representative measurements of pollutant emissions. The average gas velocity in the exhaust stack is measured by conducting Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)." The analysis of gas composition is measured by conducting Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight." These three tests provide data necessary in Method 5 for determining concentration of particulate matter in the dryer exhaust. All opacity observations would be made in accordance with the procedures established in EPA Method 9 for stack emissions.

Since the proposed standards are expressed as mass of emissions per unit mass of ammonium sulfate production, it will be necessary to quantify production rate in addition to measuring particulate emissions. Ammonium sulfate production in megagrams shall be determined by direct measurement using product weigh scales or computed from a material balance. A material balance computation based on the chemical reactions used in the formation of ammonium sulfate is an acceptable method of determining production rate since the formation reactions used in all industrial sectors are quantitative and irreversible.

If a material balance is used, the ammonium sulfate production rate for synthetic and coke oven by-product ammonium sulfate plants shall be calculated from the metered sulfuric acid feed rate to the reactor/crystallizer. For caprolactam by-product ammonium sulfate plants, production rate shall be determined from the oximation ammonium sulfate solution flow rate and the oleum flow to the caprolactam rearrangement reaction.

*Selection of Monitoring Requirements*

To further ensure that installed emission control systems continuously comply with standards of performance through proper operation and maintenance, monitoring requirements are generally included in standards of performance. In the case of ammonium sulfate dryers, the most straightforward means of ensuring proper operation and maintenance is to require monitoring of actual particulate emissions released to the atmosphere. Currently, however, there are no continuous particulate monitors in operation for ammonium sulfate dryers; and resolution of the sampling problems and development of performance specifications for continuous particulate monitors would entail a major development program. For these reasons, continuous monitoring of

particulate emissions from ammonium sulfate dryers is not required by the proposed standards.

The best indirect method of monitoring proper operation and maintenance of emission control equipment is to continuously monitor the opacity of the exhaust gas. The proposed opacity limit for ammonium sulfate dryers is 15 percent. However, in the case of ammonium sulfate dryers, the character of the exhaust gas when wet scrubbers are used for emission reduction precludes the use of continuous in-stack opacity monitors. Where condensed moisture is present in the exhaust gas stream, in-stack continuous monitoring of opacity is not feasible; water droplets and steam can interfere with operation of the monitoring instrument. Since most affected facilities are likely to use wet scrubbers, continuous monitoring of opacity is not required by the proposed standards.

An alternative to particulate or opacity monitors is the use of a pressure drop monitor as a means of ensuring proper operation and maintenance of emission control equipment. For venturi scrubbers, particulate removal efficiency is related directly to pressure drop across the venturi; the higher the pressure drop, the higher the removal efficiency. For fabric filters, pressure drop is used as an indicator of excessive filter resistance or damaged filter media. Therefore, in order to provide a continuous indicator of emission control equipment operation and maintenance, the proposed standards would require that the owner or operator of any ammonium sulfate manufacturing plant subject to the standards install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the process emission control system. The monitoring device shall have an accuracy of ±5 percent over its operating range.

The proposed standards would also require the owner or operator of any ammonium sulfate manufacturing plant subject to the standards to install, calibrate, maintain, and operate flow monitoring devices necessary to determine the mass flow of ammonium sulfate feed material to the process. The flow monitoring device shall have an accuracy of ±5 percent over its operating range. The ammonium sulfate feed streams are: for synthetic and coke oven by-product ammonium sulfate plants, the sulfuric acid feed stream to the reactor/crystallizer; for caprolactam by-product ammonium sulfate plants, the oximation ammonium sulfate stream to the ammonium sulfate plant and the oleum stream to the caprolactam rearrangement reaction.

Records of pressure drop and calibration measurements would have to be retained for at least 2 years following the date of the measurements by owners and operators subject to this subpart. This requirement is included under § 60.7(d) of the general provisions of 40 CFR Part 60.

### Public Hearing

A public hearing will be held to discuss these proposed standards in accordance with section 307(d)(5) of the Clean Air Act. Persons wishing to make oral presentations should contact EPA at the address given in the ADDRESSES section of this preamble. Oral presentations will be limited to 15 minutes each. Any member of the public may file a written statement with EPA before, during, or within 30 days after the hearing. Written statements should be addressed to the Docket address given in the ADDRESSES section of this preamble.

A verbatim transcript of the hearing and written statements will be available for public inspection and copying during normal working hours at EPA's Central Docket Section in Washington, D.C. (See ADDRESSES section of this preamble.)

### Docket

The docket is an organized and complete file of all the information considered by EPA in the development of this rulemaking. The principal purposes of the docket are: (1) To allow interested persons to identify and locate documents so that they can intelligently and effectively participate in the rulemaking process, and (2) to serve as the record for judicial review. The docket requirement is discussed in section 307(d) of the Clean Air Act.

### Miscellaneous

As prescribed by section 111 of the Act, this proposal of standards has been preceded by the Administrator's determination that emissions from ammonium sulfate manufacturing plants contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare (40 CFR 60.16, 44 FR 49222, August 21, 1979). In accordance with section 117 of the Act, publication of these proposed standards was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies. The Administrator will welcome comments on all aspects of the proposed regulation, including economic and technological issues.

It should be noted that standards of performance for new stationary sources established under section 111 of the Clean Air Act reflect:

> * * * application of the best technological system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction, any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated. (section 111(a)(1))

Although there may be emission control technology available that is capable of reducing emissions below those levels required to comply with standards of performance, this technology might not be selected as the basis of standards of performance because of costs associated with its use. Accordingly, these standards of performance should not be viewed as the ultimate in achievable emission control. In fact, the Act requires (or has the potential for requiring) the imposition of a more stringent emission standard in several situations.

For example, applicable costs do not necessarily play as prominent a role in determining the "lowest achievable emission rate" for new or modified sources locating in nonattainment areas; i.e., those areas where statutorily-mandated health and welfare standards are being violated. In this respect, section 173 of the Act requires that new or modified sources constructed in an area which exceeds the national ambient air quality standard (NAAQS) must reduce emissions to the level which reflects the "lowest achievable emission rate" (LAER), as defined in section 171(3), for such category of source. The statute defines LAER as that rate of emissions based on the following, whichever is more stringent:

> (A) The most stringent emission limitation which is contained in the implementation plan of any State for such class or category of source, unless the owner or operator of the proposed source demonstrates that such limitations are not achievable, or
>
> (B) The most stringent emission limitation which is achieved in practice by such class or category of source.

In no event can the emission rate exceed any applicable new source performance standard (section 171(3)).

A similar situation may arise under the prevention of significant deterioration of air quality provisions of the Act (Part C). These provisions require that certain sources (referred to in section 169(1)) employ "best available control technology" (as defined in section 169(3)) for all pollutants regulated under the Act. "Best available control technology" (BACT) must be determined on a case-by-case basis,

taking energy, environmental, and economic impacts and other cost into account. In no event may the application of BACT result in emissions of any pollutants which will exceed the emissions allowed by any applicable standard established pursuant to section 111 (or 112) of the Act.

In all events, State Implementation Plans (SIPs) approved or promulgated under section 110 of the Act must provide for the attainment and maintenance of the national ambient air quality standards (NAAQS) designed to protect public health and welfare. For this purpose, SIP's must in some cases require greater emission reductions than those required by standards of performance for new sources.

Finally, States are free under section 116 of the Act to establish even more stringent emission limits than those established under section 111 or those necessary to attain or maintain the NAAQS under section 110. Accordingly, new sources may in some cases be subject to limitations more stringent than EPA's standards of performance under section 111, and prospective owners and operators of new sources should be aware of this possiblility in planning for such facilities.

EPA will review this regulation four years from the date of promulgation. This review will include an assessment of such factors as the need for integration with other programs, the existence of alternative methods, enforceability, and improvements in emission control technology.

Section 317 of the Clean Air Act requires the Administrator to prepare an economic impact assessment for any new source standard of performance promulgated under section 11(b) of the Act. An economic impact assessment was prepared for the proposed regulations and for other regulatory alternatives. All aspects of the assessment were considered in the formulation of the proposed standards to ensure that the proposed standards would represent the best system of emission reduction considering costs. The economic impact assessment is included in the background information document.

Dated: January 28, 1980.

**Douglas M. Costle,**
*Administrator.*

## PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

It is proposed that 40 CFR Part 60 be amended by adding a new Subpart P as follows:

**Subpart PP—Standards of Performance for Ammonium Sulfate Manufacture**

Sec.
60.420 Applicability and designation of affected facilty.
60.421 Definitions.
60.422 Standards for particulate matter.
60.423 Monitoring of operations.
60.424 Test methods and procedures.

**Authority:** Sec. 111, 301(a), Clean Air Act as amended, (42 U.S.C. 7411, 7601(a)), and additional authority as noted below.

## Subpart PP—Standards of Performance for Ammonium Sulfate Manufacture

### § 60.420 Applicability and designation of affected facility.

The affected facility to which the provisions of this subpart apply is each ammonium sulfate dryer with an ammonium sulfate manufacturing plant in the caprolactam by-product, synthetic, and coke oven by-product sectors of the ammonium sulfate industry.

### § 60.421 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Ammonium sulfate manufacturing plant" means any plant which produces ammonium sulfate.

(b) "Ammonium sulfate dryer" means a unit or vessel in which ammonium sulfate is charged for the purpose of reducing the moisture content of the product using a heating gas stream. The unit includes foundations, superstructure, material charger systems, exhaust systems, and integral control systems and instrumentation.

(c) "Caprolactam by-product ammonium sulfate manufacturing plant" means any plant which produces ammonium sulfate as a by-product from process streams generated during caprolactam manufacture.

(d) "Synthetic ammonium sulfate manufacturing plant" means any plant which produces ammonium sulfate by direct combination of ammonia and sulfuric acid.

(e) "Coke oven by-product ammonium sulfate manufacturing plant" means any plant which produces ammonium sulfate by reacting sulfuric acid with ammonia recovered as a by-product from the manufacture of coke.

(f) "Ammonium sulfate feed material streams" means the sulfuric acid feed stream to the reactor/crystallizer for synthetic and coke oven by-product ammonium sulfate manufacturing plants; and means the oximation ammonium sulfate stream to the ammonium sulfate manufacturing plant and the oleum stream to the caprolactam rearrangement reaction for caprolactam by-product ammonium sulfate manufacturing plants.

### § 60.422 Standards for particulate matter.

On or after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator of an ammonium sulfate dryer subject to the provisions of this subpart shall cause to be discharged into the atmosphere, from any ammonium sulfate dryer, particulate matter at emission rates exceeding 0.15 kilogram of particulate per megagram of ammonium sulfate produced (0.30 pound of particulate per ton of ammonium sulfate produced) and exhaust gases with opacity of greater than 15 percent opacity.

### § 60.423 Monitoring of operations.

(a) The owner or operator of any ammonium sulfate manufacturing plant subject to the provisions of this subpart shall install, calibrate, maintain, and operate flow monitoring devices which can be used to determine the mass flow of ammonium sulfate feed material streams to the process. The flow monitoring device shall have an accuracy of ± 5 percent over its range.

(b) The owner or operator of any ammonium sulfate manufacturing plant subject to the provisions of this subpart shall install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the emission control system. The monitoring device shall have an accuracy of ± 5 percent over its operating range.

(Sec. 114, Clean Air Act as amended (42 U.S.C. 7414))

### § 60.424 Test methods and procedures.

(a) Reference methods in Appendix A of this part, except as provided in § 60.8(b), shall be used to determine compliance with § 60.422 as follows:

(1) Method 5 for the concentration of particulate matter.

(2) Method 1 for sample and velocity traverses.

(3) Method 2 for velocity and volumetric flow rate.

(4) Method 3 for gas analysis.

(b) For Method 5, the sampling time for each run shall be at least 60 minutes and the volume shall be at least 1.50 dry standard cubic meters (53 dry standard cubic feet).

(c) for each run, the particulate emission rate, E, shall be computed as follows:

$$E = Q_{sd} \times C_s \div 1000$$

(1) E is the particulate emision rate (kg/hr),

(2) $Q_{sd}$ is the average volumetric flow rate (dscm/hr) as determined by Method 2; and

(3) $C_s$ is the average concentration (g/dscm) of particulate matter as determined by Method 5.

(d) For each run, the rate of ammonium sulfate production, P (Mg/hr), shall be determined by direct measurement using product weight scales or computed from a material balance. If production rate is determined by material balance, the following equations shall be used.

(1) For synthetic and coke oven by-product ammonium sulfate plants, the ammonium sulfate production rate shall be determined using the following equation:

$$P = A \times B \times C \times 0.0808$$

where:

P = Ammonium sulfate production rate in megagrams per hour.
A = Sulfuric acid flow rate to the reactor/crystallizer in liters per minute averaged over the time period taken to conduct the run.
B = Acid density (a function of acid strength and temperature) in grams per cubic centimeter.
C = Percent acid strength in decimal form.
0.0808 = Physical constant for conversion of time, volume, and mass units.

(2) For caprolactam by-product ammonium sulfate plants the ammonium sulfate production rate shall be determined using the following equation:

$$P = [D \times E \times F \times (0.8612)] + [G \times H \times I \times (1.1620)]$$

where:

P = Production rate of caprolactam by-product ammonium sulfate in megagrams per hour.
D = Oximation ammonium sulfate process stream flow rate in liters per minute averaged over the time period taken to conduct the run.
E = Density of the process stream solution in grams per liter.
F = Percent ammonium sulfate in the process solution in decimal form.
G = Oleum flow rate to the rearrangement reaction in liters per minute averaged over the time period taken to conduct the run.
H = Density of oleum in grams per liter.
I = Equivalent sulfuric acid percent of the oleum in decimal form.
0.8612 = Physical constant for conversion of time and mass units.
1.1620 = Physical constant for conversion of time and mass units.

(e) For each run, the dryer emission rate shall be computed as follows:

$$R = E/P$$

where:

(1) R is the dryer emission rate (kg/Mg);

(2) E is the particulate emission rate (kg/hr) from (c) above; and

(3) P is the rate of ammonium sulfate production (Mg/hr) from (d) above.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414))

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